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February 14, 2013

Mr. Steven A. Dietrich, Administrator
Wyoming Department of Environmental Quality, Air Quality Division
Herschler Building
122 West 25th Street
Cheyenne, WY 82002

Subject: Naughton Unit 3 Interim Operating Scenario Air Modeling

Dear Mr. Dietrich:

This submittal provides the air modeling report which supplements PacifiCorp's February 6, 2013 letter regarding the Naughton Unit 3 interim operating scenario. The results of the modeling indicate that the interim operating and emissions limits proposed for Naughton Unit 3 will provide significant visibility improvements when compared to the Naughton 3 Regional Haze Baseline. And as identified in the February 6, 2013 letter, there will be a significant reduction in the annual PM, SO_2 and NO_X emissions during the interim period.

Table 1 below compares the modeled visibility impacts associated with 1) the Regional Haze baseline, 2) the interim operation of Unit 3 on coal, 3) the operation of the unit with the proposed BART controls, and 4) the operation of the unit on gas. Although PacifiCorp continues to question the accuracy of the models that have been required, we believe the relative results can be used to demonstrate that the requested Naughton Unit 3 interim operating scenario will have a positive impact on visibility.

Table 1 - Bridger Wilderness

98th Percentile Impact (dV)

Model	2001	2002	2003	AVG
Naughton 3 Regional Haze Baseline	1.978	1.618	2.171	1.922
Interim Operating Scenario	1.317	1.095	1.438	1.283
State/EPA Proposed BART Controls	0.710	0.650	0.830	0.730
Gas Conversion	0.275	0.241	0.345	0.287

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Table 1 - Bridger Wilderness				
Number of Days > 0.5 Delta dV				
Model	**2001**	**2002**	**2003**	**AVE**
Naughton 3 Regional Haze Baseline	66	56	53	58
Interim Operating Scenario	44	32	37	38
State/EPA Proposed BART Controls	17	10	14	14
Gas Conversion	3	3	1	2

Additional details and modeling results are contained in Attachment 1. (CH2M HILL Naughton Unit 3 Interim Operation CALPUFF Modeling Report)

PacifiCorp would like to make a correction to the time period that was proposed for the interim operation of the unit on coal. The February 6, 2013 letter requested that PacifiCorp be allowed to burn coal at reduced operating and emission rates during an interim period that commenced with the MATS compliance date and ended December 31, 2017. Since EPA's SIP/FIP determination has been delayed, PacifiCorp is requesting that the interim period be defined as the period beginning with the MATS compliance date and ending five years after the EPA has approved a Naughton regional haze SIP or FIP. The reason for this request is based upon PacifiCorp's desire to reduce impacts to its customers by mitigating as much of the facility's existing coal contract obligations as possible prior to ceasing coal operations at Naughton Unit 3.

In addition, PacifiCorp has received additional information related to the NOx emission rate that will be achievable following the gas conversion. It is expected that a 0.08 lb/MMBtu emission rate can be achieved with the use of flue gas recirculation. Accordingly, PacifiCorp wishes to modify its request to reflect the use of the 0.08 lb/mmBtu rate rather than the 0.10 lb/MMBtu rate. The following table is an update of the Table 2 that was provided in our January 28, 2013 letter. The updated table reflects the use of the lower 0.08 lb/MMBtu NO_X emission rate

Updated Table 2 - Changes in Annual SO_2, NO_X and PM Emissions if Naughton 3 is Converted to Natural Gas Rather than Install BART Controls

Parameter	Coal (BART Limits)	Gas Firing	Difference
Unit Hourly Heat Input, MMBtu/hr	3,700	3,700	0
Annual Capacity Factor	90%	40%	(50%)
Unit Annual Heat Input, MMBtu/yr	29,170,800	12,964,800	(16,206,000)
Controlled SO_2 Rate, lb/MMBtu	0.22	0.0006	(0.2194)
Hourly SO_2 Emissions, lb/hour	814	2	(812)
Annual SO_2, tons/year	3,209	4	(3,205)

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Parameter	Coal (BART Limits)	Gas Firing	Difference
Controlled NOx Rate, lb/MMBtu	0.07	0.08	0.01
Hourly NO_X Emissions, lb/hour	259	296	37
Annual NO_X, tons/year	1,021	519	(502)
Controlled PM Rate, lb/MMBtu	0.015	0.008	(0.007)
Hourly PM Emissions, lb/hour	56	30	(26)
Annual PM, tons/year	219	52	(167)
SUMMARY - Reductions Beyond BART Determined Emissions			
Reduction in Annual SO_2 Emissions, tons/year			3,205
Reduction in Annual NO_X Emissions, tons/year			502
Reduction in Annual PM Emissions, tons/year			167

Please contact me at (801) 220-4581 or Jim Doak at (801) 220-2306 if you have any questions or comments regarding this request seeking authorization of the proposed Naughton Unit 3 interim operating scenario.

Sincerely,

William K. Lawson
Director, Environmental Services

Attachments:
Attachment 1: CH2M HILL Interim Operation CALPUFF Modeling Report

c: Cole Anderson – NSR Air Quality Engineer, Wyoming Air Quality Division
Jim Doak
Richard Goff
Craig Lucke
Jason Murdock
Dana Ralston
Shawn Smith
Chad Teply
Scott Wetzel
Frank Zampedri

Attachment 1

CH2M HILL Naughton Unit 3 Interim Operation CALPUFF Modeling Report[1]

[1] Interim operation commences at implementation of MATS rule and ends within five years following the EPA's approval of the state's 309(g) regional haze SIP or implementation of a FIP

Naughton Unit 3 Reduced Load Coal Firing CALPUFF Modeling

Introduction

On May 28, 2009, Wyoming Department of Environmental Quality Air Quality Division issued the BART Application Analysis for PacifiCorp Naughton Power Plant. The analysis determined control strategies for improving visibility impairments. PacifiCorp has requested additional CALPUFF modeling be conducted for Naughton Unit 3 using Wyoming Department of Environmental Quality and EPA modeling procedures with updated emissions based on natural gas firing. Additionally, prior to final conversion of Unit 3 to natural gas, there will be a defined interim period where emissions would be a hybrid of coal and natural gas firing. Therefore, additional modeling was conducted to determine the magnitude of impacts at the Class I areas for the interim/ transitional period as well. The results from this analysis would then be compared to the previous BART CALPUFF modeling analyses of each control technology option for maximum delta-deciview, 98th percentile delta-deciview, and days above 0.5 delta-deciview at the Class I areas of concern.

This modeling memorandum presents the dispersion modeling methods and results from estimating the degree of visibility improvement from each control technology option for Naughton Unit 3 located in southwestern Wyoming, as well as natural gas firing and the interim period during the transition to natural gas.

Model Selection

The BART modeling assessment used the CALPUFF modeling system (version 5.7) to assess the visibility impacts at Class I areas. CALPUFF is a multi-layer, multi-species, non-steady-state puff dispersion model that simulates the effects of time- and space-varying meteorological conditions on pollution transport, transformation, and removal. BART guidance says, "CALPUFF is the best regulatory modeling application currently available for predicting a single source's contribution to visibility impairment and is currently the only EPA-approved model for use in estimating single source pollutant concentrations resulting from the long range transport of pollutants."

The CALPUFF modeling system also includes the CALMET meteorological data preprocessing program and the CALPOST post processor capable of refining concentration estimates, visibility impacts, and deposition.

Table 1 below summarizes the model versions and post-processing routines utilized to conduct BART CALPUFF assessment.

TABLE 1	
EPA BART CALPUFF Modeling System Versions	
CALPUFF Module	**Utilized Version**
CALMET	5.53a Level 040716
CALPUFF	5.711a Level 04716
POSTUTIL	N/A
CALPOST	5.51 Level 030709
Notes	Used constant 2.0 ppb ammonia

This assessment of Naughton Unit 3 used the identical meteorological data, CALPUFF model versions, and post-processing routines utilized by EPA. EPA Region 8 supplied the modeling files for Naughton Unit 3 for the coal control options analyzed, and these were used as the template for this analysis.

CALPUFF Methodology

Modeling Process

The modeling of Naughton Unit 3 with CALPUFF followed this sequence:

- Model Naughton Unit 3 during the interim/ transitional period converting from coal firing to natural gas firing.
- Model Naughton Unit 3 firing natural gas and determine impacts at the nearby Class I areas
- Determine the most impacted Class I area
- Compare to the EPA modeled results

CALPUFF Modeling

The MESOPUFF II chemical transformation scheme was used by EPA in the CALPUFF model. It is used within CALPUFF to calcul ate transformation pathways for five active pollutants (SO_2, sulfates, NO_x, nitric acid, and nitrates). The oxidation of NO_x is dependent on photochemical reactions with reactive organic gases (ROG) and ozone. NO_x can be oxidized to nitric acid, which in turn can be converted to aqueous ammonium nitrate through an equilibrium reaction with HNO_3. Because of the preferential scavenging of ammonia by sulfate, the available ammonia is computed as the total ammonia minus available sulfate. Therefore the ambient background concentration of ammonia is critical to the ambient concentrations of ammonium nitrate, which is an important particulate compound contributing to the estimated visibility impacts.

Ambient Ammonia Concentrations

There are limited real-time or historical ambient concentration measurements of ammonia within the southwest Wyoming modeling domain and therefore it is doubtful that the assumed 2 parts per billion (ppb) background ammonia concentration that EPA utilized in its analysis would be representative of th e entire CALPUFF modeling domain throughout the year. However, the 2ppb value was used for this Naughton Unit 3 modeling. It should

be noted that due to colder temperatures in the spring, fall, and winter, and a lack of agricultural activity in proximity to many of the Class I areas, the amount of ammonia available to convert NO_x and SO_2 to ammonium nitrate and sulfate respectively is likely more limited than 2 ppb.

Ambient Ozone Concentrations

The transformation rates of gaseous SO_2 and NO_x are dependent on the ambient concentrations of ozone. Temporally varying ozone values from a number of monitoring stations within the domain can be used within the model to estimate the transformation rates of SO_2 and NO_x.

Ozone data used by EPA for the analysis were considered representative of the CALPUFF domain and were utilized for the CALPUFF modeling of Naughton Unit 3.

Naughton Stack Parameters and Emissions

The Naughton Unit 3 stack parameters firing natural gas, and during the interim/ transitional period comprising coal and natural gas firing, were supplied by PacifiCorp staff. The stack parameters are summarized in Attachment A.

For Naughton Unit 3, the emissions for each scenario were speciated into the constituents described below:

- Sulfur dioxide (SO_2)
- Oxides of nitrogen (NO_x)
- Fine particulate (diameter less than or equal to $PM_{2.5}$)
- Coarse particulate (diameter between $PM_{2.5}$ and PM_{10})
- Sulfate (SO_4)
- Nitrate (NO_3)
- Nitric Acid (HNO_3)

Emissions supplied for both the natural gas firing and transitional period to natural gas of Naughton Unit 3 were for particulate matter, nitrogen oxides, and sulfur dioxide. It is conservatively assumed all PM from the unit would be $PM_{2.5}$ for the natural gas firing scenario. Breakdown of PM_{10} and $PM_{2.5}$ were supplied by PacifiCorp for the transitional period.

Class I Areas and Receptor Grids

Class I areas evaluated for modeling the proposed interim/ transitional period and natural gas firing of Naughton Unit 3 were identical to the EPA Region 8 modeling analysis. The following lists the Class I areas that were modeled for this analysis:

Class I Area

- Bridger Wilderness
- Fitzpatrick Wilderness
- Grand Teton NP
- Teton Wilderness
- Yellowstone NP
- Washakie Wilderness
- North Absaroka Wilderness

Visibility Post-processing

CALPOST

The CALPOST module was used to determine 24-hour average visibility results. Output is specified in deciview (dV) units. The FLMs' recommended procedure for determining Class I visibility impacts require the use of Method 8, however, the EPA assessment used Method 6. Therefore Method 6 was used in this analysis.

Calculations of light extinction were made for each pollutant modeled. The sum of all extinction values was used to calculate the delta-dV (ΔdV) change relative to annual average natural background. The following default light extinction coefficients for each species were used:

- Ammonium sulfate 3.0
- Ammonium nitrate 3.0
- PM coarse (PM_{10}) 0.6
- PM fine ($PM_{2.5}$) 1.0
- Organic carbon 4.0
- Elemental carbon 10.0

CALPOST Visibility Method 6 (MVISBK=6) was used for the determination of visibility impacts. Identical inputs from the EPA Region 8 modeling files were used for this assessment.

Results

Modeling Results

Table 2 below summarizes the CALPUFF modeling analysis results for Naughton Unit 3 during the interim/ transitional period and while firing natural gas at the Bridger Wilderness Area. Bridger Wilderness Area was the Class I area with the greatest impact from Naughton Unit 3. A complete summary of all modeling results for each Class I area are summarized in Attachment B.

The results are daily delta deciview averages and the highest daily, eighth highest daily and average of eighth highest daily at one receptor within the Class I area for a given year or range of years. Also, the days above 0.5 delta-deciview are presented.

TABLE 2

Naughton Unit 3 Interim/Transitional Period: Bridger Wilderness Impact Results				
Impact	**2001**	**2002**	**2003**	**Average**
Maximum delta-DV	4.200	3.195	2.825	3.407
98th percentile delta-DV	1.317	1.095	1.438	1.283
Number of Days >0.5 delta-DV	44	32	37	44[a]
Naughton Unit 3 Natural Gas: Bridger Wilderness Impact Results				
Impact	**2001**	**2002**	**2003**	**Average**
Maximum delta-DV	0.948	0.831	0.732	0.837
98th percentile delta-DV	0.275	0.241	0.345	0.287
Number of Days >0.5 delta-DV	3	3	1	3[a]

[a] Maximum of the three years

Table 3 below summarizes the impacts from the third control option evaluated by EPA Region 8 at Bridger Wilderness Area to Naughton Unit 3 during the interim/ transitional period and Unit 3 fueled on natural gas. Overall, the analysis demonstrates that the unit fueled on natural gas shows visibility impacts below the 0.5 delta-dV BART applicability threshold and impacts firing natural gas would be below the most stringent control technology modeled by EPA Region 8. Table 4 summarizes the same parameters but for the Fitzpatrick Wilderness Area.

TABLE 3

Comparison to EPA results

Bridger Wilderness Area

98th Percentile Impact (dV)

Model	2001	2002	2003	AVG
EPA 3 Control Option (Scenario B: PacifiCorp committed controls and selective catalytic reduction (SCR) at permitted rates)	0.710	0.650	0.830	0.730
Interim/Transitional Period	1.317	1.095	1.438	1.283
New Gas Conversion	0.275	0.241	0.345	0.287

Number of Days >0.5 Delta dV

Model	2001	2002	2003	Max
EPA 3 Control Option (Scenario B: PacifiCorp committed controls and selective catalytic reduction (SCR) at permitted rates)	17	10	14	17
Interim/Transitional Period	44	32	37	44
New Gas Conversion	3	3	1	3

TABLE 4

Comparison to EPA results

Fitzpatrick Wilderness Area

98th Percentile Impact (dV)

Model	2001	2002	2003	AVG
EPA 3 Control Option (Scenario B: PacifiCorp committed controls and selective catalytic reduction (SCR) at permitted rates)	0.372	0.287	0.259	0.306
Interim/Transitional Period	0.675	0.534	0.509	0.573
New Gas Conversion	0.154	0.114	0.134	0.134

Number of Days >0.5 Delta dV

Model	2001	2002	2003	Max
EPA 3 Control Option (Scenario B: PacifiCorp committed controls and selective catalytic reduction (SCR) at permitted rates)	4	3	1	4
Interim/Transitional Period	12	11	8	12
New Gas Conversion	0	1	0	1

References

- Federal Land Managers' Air Quality Related Values Work Group, Phase I – Revised (2010), Natural Resources Report, NPS/ NRPC/ NRR – 2010/ 232, October 2010.
    - National Park Service/ Federal Land Managers Particulate Matter Speciation Workbook, accessed December 11, 2012: http:/ / www2.nature.nps.gov/ air/ perm its/ ect/ ectCoalFiredBoiler.cfm?CFID=9494566&CFTOKEN=90762878
- Colorado Department of Public Health (1996). *Mt. Zirkel Wilderness Area. Reasonable Attribution Study of Visibility Impairment*. Final Report. July 1996

Attachment A

Stack Parameters

Model Input Data	Interim/Transitional Period	Gas Conversion
Heat Input (MMBtu/hr)	3,145	3,700
SO_2 Stack Emissions (lb/MMBTU)	0.2	0.0006
SO_2 Stack Emissions (lb/hr)	629	2
NO_x Stack Emissions (lb/MMBTU)	0.4	0.1
NO_x Stack Emissions (lb/hr)	1,258	370
PM_{10} Stack Emissions (lb/MMBTU)	0.035	0.01
PM_{10} Stack Emissions (lb/hr)	110	37
PM_{10}-$PM_{2.5}$ Stack Emissions (lb/hr)	47.3	0
$PM_{2.5}$-PM_{10} Stack Emissions (lb/hr)	62.7	37
Total Sulfate (as SO_4) (lb/hr)	26.6	neg
Stack Conditions		
Stack Height (feet)	475	475
Stack Height (meters)	145	145
Stack Exit Diameter (feet)	26.5	26.5
Stack Exit Diameter (meters)	8.08	8.08
Stack Exit Temperature (degF)	323	315
Stack Exit Temperature (degK)		
Stack Exit Flow (lb/hr)		3,591,887
Stack Exit Area (square feet)	552	552
Stack Exit Velocity (feet per second)		43.51
Stack Exit Velocity (meters per second)	20.3	
Site Elevation feet above mean sea level	6939	6939
Latitude deg: min : sec	41:45:31.91	41:45:31.91
Longitude deg: min : sec	110:35:49.47	110:35:49.47
Type of Boiler	Tangentially-fired	Tangentially-fired
Boiler Fuel	Coal	Gas

Note: Black Cells indicate parameters not supplied by PacifiCorp.

Attachment B

Naughton Unit 3 Natural Gas Firing CALPUFF Modeled Results

Naughton Unit 3

Impacts expressed as delta deciviews

Days expressed as whole days

Scenario: Gas Conversion Emissions

	Bridger Wilderness				Fitzpatrick Wilderness				Grand Teton NP				North Absaroka Wilderness			
	2001	2002	2003	Max	2001	2002	2003	Max	2001	2002	2003	Max	2001	2002	2003	Max
Highest Impact (dV)	0.948	0.831	0.732	0.948	0.441	0.673	0.271	0.673	0.286	0.34	0.233	0.34	0.163	0.307	0.097	0.307
98th Percentile Impact (dV)	0.275	0.241	0.345	0.345	0.154	0.114	0.134	0.154	0.131	0.188	0.103	0.188	0.073	0.065	0.038	0.073
Number of Days >0.5delta DV	3	3	1	3	0	1	0	1	0	0	0	0	0	0	0	0

	Teton Wilderness				Washakie Wilderness				Yellowstone NP			
	2001	2002	2003	Max	2001	2002	2003	Max	2001	2002	2003	Max
Highest Impact (dV)	0.235	0.292	0.193	0.292	0.175	0.25	0.228	0.25	0.186	0.302	0.189	0.302
98th Percentile Impact (dV)	0.106	0.148	0.092	0.148	0.118	0.113	0.08	0.118	0.119	0.122	0.063	0.122
Number of Days >0.5delta DV	0	0	0	0	0	0	0	0	0	0	0	0

Naughton Unit 3

Impacts expressed as delta-deciviews

Days expressed as whole days

Scenario: Interim/Transitional Period

	Bridger Wilderness				Fitzpatrick Wilderness				Grand Teton NP				North Absaroka Wilderness			
	2001	2002	2003	Max	2001	2002	2003	Max	2001	2002	2003	Max	2001	2002	2003	Max
Highest Impact (dV)	4.2	3.195	2.825	4.2	1.999	2.656	1.144	2.656	1.302	1.475	1.41	1.475	0.764	1.143	0.53	1.143
98th Percentile Impact (dV)	1.317	1.095	1.438	1.438	0.675	0.534	0.509	0.675	0.597	0.651	0.459	0.651	0.317	0.343	0.171	0.343
Number of Days >0.5delta DV	44	32	37	44	12	11	8	12	13	10	4	13	3	4	1	4

	Teton Wilderness				Washakie Wilderness				Yellowstone NP			
	2001	2002	2003	Max	2001	2002	2003	Max	2001	2002	2003	Max
Highest Impact (dV)	0.933	1.201	0.919	1.201	0.814	0.891	1.063	1.063	0.762	1.459	0.774	1.459
98th Percentile Impact (dV)	0.508	0.564	0.355	0.564	0.475	0.444	0.342	0.475	0.486	0.516	0.247	0.516
Number of Days >0.5delta DV	8	8	4	8	7	6	2	7	7	9	3	9